



ORIGINAL ARTICLE

Cost and potential savings generated by a paediatrics e-Health web site for parents[☆]



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Abstract

Introduction: There are few studies on e-Health interventions directed at parents that analyse their costs and any potential savings that may occur. The aims of this study consisted of calculating the costs of the development and maintenance of a paediatric web site for parents, including the costs per visit and per visitor, and the potentially savings made as regards medical visits avoided as a result of its use.

Methods: The technology costs as well as the work of the professionals were considered as costs of the web site. The calculation of the cost of the professionals and the potential savings were based on the official fees and public prices of the Andalusian Public Health Service.

Results: During 5 years and 6 months of the study, the total cost of the web site was €45,201.56. The cost per visit received was €0.0155€, and €0.0186 for each single visitor. Among the 516 users that took part in the study, face-to-face visits to Primary Care paediatric clinics were avoided, as well as those to Paediatric Emergency Department, at a savings of €22,263.89.

Conclusions: The costs of developing a paediatric e-Health website for parents written in Spanish, using existing and free technologies, are low compared to other forms of e-Health development. Furthermore, the costs are considerably low if they are divided by the total number of visits or the number of visitors. There is also a considerable potential financial saving on contributing to avoid face-to-face visits.

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PALABRAS CLAVE

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Coste y ahorro potencial generado por una web de eSalud de pediatría para padres**Resumen**

Introducción: Son pocas las intervenciones de eSalud dirigidas a padres que analizan sus costes y el ahorro potencial que pueden generar. Los objetivos de este trabajo consistieron en calcular los costes de desarrollo y mantenimiento de una web de pediatría para padres, el coste por visita y por visitante, y el ahorro potencial generado en función de las visitas médicas evitadas como consecuencia de su uso.

Métodos: Para los costes de la web se consideraron los costes tecnológicos y del trabajo de los profesionales. El cálculo del coste de los profesionales y de ahorro potencial se basaron en los honorarios oficiales y en los precios públicos del Sistema Sanitario Público de Andalucía.

Resultados: Durante los 5 años y 6 meses del estudio el coste total de la web fue de 45.201,56€. El coste por visita recibida fue de 0,0155€, y por cada visitante único, de 0,0186€. Entre los 516 usuarios que participaron en el estudio se evitaron visitas presenciales a las consultas de pediatría de atención primaria y a los servicios de urgencias de pediatría por un valor de 22.263,89€.

Conclusiones: Los costes de desarrollo de una web de eSalud de pediatría para padres escrita en español, usando tecnología existente y gratuita, son bajos en comparación a otras formas de desarrollo de eSalud. Además, los costes son considerablemente bajos si se dividen entre el número de visitas totales o el número de visitantes. También existe un potencial considerable de ahorro económico al contribuir a evitar visitas presenciales.

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Introduction

Technology offers the possibility of widely implementing evidence-based interventions, therefore cutting costs.^{1–3} However, the economic aspects of eHealth interventions are rarely discussed,^{4,5} especially when it comes to interventions addressed to parents.^{3,4} These interventions tend to be expensive, including the costs of technology and of the time invested by development teams.⁵ Detailed cost-benefit analyses are required to assess eHealth interventions. It should be possible to collect data on costs for all eHealth development projects.⁶

One way to reduce costs and improve efficiency in any intervention would be the incremental addition of components, so their use by the target audience and the response to each could be analysed in turn. Another option would be to use already existing commercial or free tools in the development,⁵ as eHealth interventions tend to be more cost-effective if widely available technologies are used.³ Recruiting individuals with experience in eHealth interventions to form development teams can also improve efficiency.⁵

Electronic health interventions can be cost-saving, especially if they succeed in reducing the number of in-person medical visits.^{7,8} Many patients search health information online. These patients would receive better information and guidance on whether or not to visit a doctor, which would lead to a reduction in health care utilization.⁹ Thus, it is important to assess the savings that may be achieved through the use of eHealth interventions.¹⁰

We performed a cost analysis in the context of a study that assessed an eHealth webpage offering information on

paediatric medicine to parents, in Spanish, written in plain language. Our goals were to calculate the cost of developing and maintaining the website, calculate the cost per visit and user and estimate the potential savings accrued based on the in-person medical visits that may have been prevented as a result of using the website.

Methods**Study design**

The website notodoespediatria.com is a paediatrics website for parents written in Spanish that is open-access and free to users. Its contents are organised into 338 paediatrics subjects offering evidence-based information on symptoms, diseases and the care of healthy children, written in plain language by paediatricians. The website was developed using the free content management system WordPress.com (Automattic Inc., San Francisco, USA). Its main mission is to provide parents with evidence-based information on paediatric care, and the website has been certified by the Health on the Net Foundation.

Before performing the cost analysis and with the aim of assessing the ease of use, usefulness, trust, accessibility and healthy child section of the website from the perspective of the user, we developed a questionnaire validated through analyses of content and construct validity and reliability. The Chronbach α for the questionnaire was 0.8. The exploratory factor analysis identified 5 constructs/domains (ease of use, usefulness, trust, healthy child section and accessibility) that explained 74.68% of the variance, which

were confirmed by the confirmatory factor analysis. The questionnaire was developed with the Google Forms tool (Google LLC, Mountain View, USA) and made available to the website users for a period of 8 weeks, during which we received 516 responses. The ratings given by respondents were very positive for every domain analysed. The demographic data collected from the respondents included the age and sex of the respondent, the number of children and age of the youngest child, educational attainment, household income, country of residence and residential setting (rural/urban).

We performed the statistical analysis with the software SPSS version 26 (IBM Inc., Armonk, NY, USA). To validate the questionnaire, we performed an exploratory factor analysis to determine which items to include in the final version. We assessed the psychometric properties of the questionnaire by performing tests to assess the construct validity, internal consistency and split-half reliability. We performed the confirmatory factor analysis with the software AMOS version 26.0.0 (IBM Inc., Armonk, NY, USA). The study was based on secondary data sources and we did not collect personal information of any kind, so it did not require approval by an ethics committee.

Method used to calculate costs

We calculated the cost per work hour based on the salary (in euro) of a hospital-based specialty doctor employed by the Public Health System of Andalusia (PHSA) for 2019 divided by the hours worked per year. We obtained salary range information (in euro) and the number of work hours per year established by the law from Resolution 0003/19, of 10 January of the General Directorate of Professionals on the Wages of the Personnel of Health Care Centres and Institutions for the 2019 Fiscal Year¹¹ and Royal Decree/Law 24/2018, of 21 December.¹² Based on these dispositions, the annual gross pay of a hospital-based specialty doctor of the PHSA in 2019 was of €45 917.70 for a total of 1645 h worked.

We calculated website costs including development and maintenance costs. The development costs included site and content development costs. The contents cover 338 subjects, and the mean time used to write the contents on each subject was of 3 h. The development of the website (design, structure, content upload and management) required 30 work hours. Maintenance costs included the hours of work required to update contents, monitoring user comments and advertise the site and its contents in social media. This maintenance required 2 h of work per week. There were no costs associated with hosting, as WordPress offers it for free. The cost of registering the domain (registration of the domain name *notodoespediatria.com* online) was €18 a year, paid through WordPress.

We estimated economic savings on account of avoided in-person medical visits based on the answers to 2 out of the 3 items of the questionnaire that, based on the exploratory and confirmatory factor analyses, defined the website usefulness domain: "Have you ever avoided a visit to the paediatrician as a result of using *notodoespediatria*?" and "Have you ever avoided an emergency room visit as a result of using *notodoespediatria*?". We also asked the question

"Have you ever decided to visit the doctor or paediatrician as a result of what you have read in *notodoespediatria*?"

To establish the cost of paediatric visits in public primary care services we used as reference the Order of 8 May 2018 of the Boletín Oficial de la Junta de Andalucía (BOJA no. 92 of 15/05/2018),¹³ amending Order of 14 October 2005 (BOJA no. 210 of 27/10/2005)¹⁴ establishing the rates for public health services provided by facilities of the PHSA. This Order established a rate of €53.75 for billing code "I.1.1.1. Primary care medical visit during regular business hours". To establish the cost of visits to emergency departments in public hospitals, we used as reference the Order of 14 October 2005 establishing the rates for public health services provided by facilities of the PHSA (BOJA no. 210 of 27/10/2005).¹⁴ This order established a rate of €144.24 for billing code "III.2.3.3.1. Emergency visit: care for low urgency emergent conditions" in the hospital setting.

Method used to calculate the number of visits and visitors to the website

We collected and obtained data from the WordPress servers. The 2 units used to measure website traffic were visits and individual users. We counted as a visit any instance of a user loading a page. We counted as an individual user any instance of detecting a user or visitor for the first time in a given time period. The data collection period (for total visits and individual users) was of 5 years and 6 months.

Results

Total visits and web-only visitors

In the 5 years and 6 months under study, the *notodoespediatria.com* website received a total of 2 909 785 visits from 2 432 167 individual users.

Response rate and demographic characteristics of respondents

In the 8 weeks that the questionnaire was available, the website received 117 032 visits from 98 577 individual users, of who 516 (0.52%) participated in the study by correctly completing 516 questionnaires. Of the total participants, 92.2% ($n = 476$) resided in Spain, 67.8% ($n = 350$) were female and 32.2% ($n = 166$) were male. The mean age was 38.81 years (standard deviation, 6.06). Most participants had 1 child (35.3%; $n = 182$) or 2 children (53.7%; $n = 277$). The mean age of the children was 4.62 years (standard deviation, 4.00). [Table 1](#) summarises other demographic characteristics of participants.

Site development and maintenance costs

Website-associated costs included development and maintenance costs ([Table 2](#)). The development of the online contents required 1014 h of work which, multiplied by the hourly rate of a hospital-based paediatrician in the Andalusian public health system in 2019 (€27.91/h), amounted to €28 300.74. The development of the site itself required 30 h

Table 1 Demographic characteristics of the respondents.

Age, mean (SD)		
Age of respondents, years	38.81	(6.06)
Age of youngest child, years	4.62	(4.00)
Sex distribution, n (%)		
Female	350	(67.8)
Male	166	(32.2)
Educational attainment, n (%)		
Master/other postgraduate degree	128	(24.8)
University degree	253	(49.0)
Secondary school/Bachillerato	92	(17.8)
Primary school/elementary diploma	20	(3.9)
Other	23	(4.5)
Distribution by income, n (%)		
>€75 000/year	57	(11.0)
€51 000-€75 000/year	92	(17.8)
€26 000-€50 000/year	190	(36.8)
€11 000-€25 000/year	133	(25.8)
<€10 000/year	44	(8.5)
Country/region of residence, n (%)		
Spain	476	(92.2)
Central/South America	24	(4.7)
North America	12	(2.3)
Other European country	3	(0.6)
Africa	1	(0.2)
Residential setting, n (%)		
Urban	403	(78.1)
Rural	113	(21.9)
Total participants	516	(100)

SD: standard deviation.

of work, amounting to a cost of €837.30. Thus, the total cost of developing the website was €29 138.04. As for maintenance costs, in the 5 years and 6 months during which we collected data for this study, maintenance costs added up to €15 964.52 (€2902.64/year). The cost of registering the domain notodoespediatria.com was €99 (€18/year). Thus, the total cost of maintaining the website for the 5 years and 6 months under study was €45 201.56.

Cost per visit and per visitor

During the data collection period, the website received 2909.785 visits from 2432.167 individual users. This corresponded to a cost of €0.0155 (1.55 cents) per visit and €0.0186 (1.86 cents) per single user.

Reduction in office visits

Of the 516 users that participated in the survey to evaluate the website, 152 (29.45%) reported that they had decided to visit their paediatrician after visiting the site; 188 (36.5%) reported they had avoided one or more visits to the paediatrician, and 141 (27.3%) that they had avoided one or more visits to an emergency department (Table 3). Applying the public rates established by the PHSA,^{13,14} the costs generated by respondents as a consequence of consulting the website amounted to €8172.83. The potentially saved costs would be of at least €10 101.50 on account of avoided visits to the paediatrician and €20 335.22 on account of avoided emergency visits. These calculations include the cost per individual user visiting the website (€0.0186). We found no statistically significant association between the avoidance of visits to the paediatrician and the country of residence (Pearson chi square, linear by linear association, 0.029; *P* = .86), or between avoidance of emergency visits and country of residence (Pearson chi square, linear by linear association, 0.39; *P* = .53).

Discussion

One of the main activities necessary to advance eHealth is the performance of cost analyses.⁵ Yet, the economic aspects of eHealth interventions are rarely discussed,^{4,5} especially when it comes to interventions addressed to parents.^{3,4} Since gathering data on costs should be easy during the development of these interventions,⁶ cost analyses should be performed in every one of them.^{4,6} In the reviewed literature, we did not find any studies or analyses of the costs associated with developing and maintaining paediatric eHealth websites in Spanish and aimed at parents. In our study, we calculated the costs of developing and maintain-

Table 2 Costs of development and maintenance of the website notodoespediatria.com.

	Development costs		
	Hours worked	Cost/hour	Total
Website contents	1014	€27.91	€28 300.74
Website development	30	€27.91	€837.30
Total development costs			€29 138.04
	Maintenance costs (5 years and 6 months)		
	Hours worked	Cost/hour	Total
Maintenance	572	€27.91	€15 964.52
Domain	Annual: €18.00		Total: €99.00
Total maintenance cost			€16 063.52
Total website cost (maintenance + development)			€45 201.56

Table 3 Estimates of generated costs and savings corresponding to the study participants.

	Number	Rate	Website cost per user	Cost/generated savings
Generated primary care visits	152	53.75€	0.0186€	8172.83€
Avoided primary care visits	-188	53.75€	0.0186€	-10 101.50€
Avoided emergency visits	-141	144.24€	0.0186€	-20 335.22€
Total				-22 263.89€

ing a website for parents, including the cost per visit and per user, and estimated the potential savings achieved based on the medical visits that may have been avoided. According to some authors, cost calculations should include the costs of technology itself and the hours worked by the development team.⁵ In our study we calculated the costs based on the costs of technology and the work involved in the development of the website based on the salary of a paediatrics specialist in the PHSA.

Other authors have suggested several possible strategies to reduce costs and improve efficiency in the development of eHealth interventions. One example is to add components one at a time and assessing how they are being utilised by users.⁵ One of the goals in developing our website was to have low costs without compromising its ease of use, usefulness, trustworthiness and accessibility online. For this reason, before carrying out the cost analysis we surveyed the users, whose assessment of the site was positive in every aspect presented to them. Another significant possibility suggested by some authors is to use already existing free or commercial in the development,^{3,5} which would reduce costs and would allow easy adaptation for mobile devices.¹⁵ Our findings support this strategy: our costs not only were low but, according to users, the website also adapted well to different devices. Another recommendation for increasing efficiency is to engage professionals with previous experience in the development of eHealth interventions.⁵ In our particular case, the experience with technology of the paediatrician that created the website helped keep the development and maintenance costs low. If professional services had been used to develop, host and maintain the site, which would be a requisite if the project had been carried out officially at the institutional level, the costs would have been higher.

Although costs vary based on many other factors, eHealth interventions are rarely inexpensive.⁵ The average cost of developing a specific application would be of approximately \$270 000, and development would take between 7 to 12 months. Later on, additional work would be required for updates and maintenance. However, the average cost of a web-based intervention ranges from \$5640 to \$29 900, and its development takes from 10 to 16 weeks.¹⁵ Since we used a web-based format, the results of our study were consistent with the latter ranges: the development cost was of €29 138.04 and subsequent maintenance costs were of €2920.64 per year, well below the costs of a specific application.

When it comes to the assessment of potential savings made through eHealth interventions, the results published in the literature are heterogeneous. A web-based intervention that offered information about the measles, mumps and

rubella vaccine to guide parental decision-making that was compared to the handing out of brochures at the doctor's office was found to increase cost-effectiveness.¹⁶ A study of an internet-delivered therapy for management of obsessive compulsive disorder in the paediatric population found savings of \$145 per patient.¹⁷ On the other hand, a systematic review of paediatric telemedicine interventions found that while some of them saved costs, others had similar or even higher costs.¹⁸ In our study, we found low development and maintenance costs, especially if we divided them by the number of visits or individual users.

As for the number of avoided in-person visits, we ought to highlight that 92.2% of participants in the study (476 individuals) resided in Spain and that we did not find statistically significant differences in the number of avoided visits to the primary care paediatrician or the emergency department based on the country of residence. Some studies have found that consultation of online information did not reduce the number of in-person visits or even increased in.^{19,20} However, other authors have found evidence suggesting that eHealth interventions can reduce costs through preventing in-person visits.⁸ The reason is that many patients look for health information online, and that these resources would inform them better regarding the need to see a doctor.⁹ The results of our study seem to support the latter hypothesis, since, as a result of using the website, participants in our study would have made visits to the primary care paediatrician with an estimated cumulative cost of €8172.83, but would have also avoided in-person visits to primary care paediatricians amounting to a minimum estimated value of €10 101.50, as well as emergency department visits amounting to a minimum of €20 335.22, corresponding to net savings for the total sample of €22 263.89.

However, it would not be reasonable to extrapolate this result or the result on the total number of avoided in-person visits to the entire population of users of the website, as it is possible that only those that found the website useful responded to the survey. Or that in the group that did not participate in the study (99.48% of the total users), the proportion that avoided visits was much lower or the proportion that decided to visit the paediatrician after using the site higher.

Although the sample may not be representative, as there is an unavoidable self-selection bias in open online questionnaires²¹ and we would need to carry out analyses to assess the impact of potential biases and whether the avoided visits were actually necessary, we can assert, in agreement with other authors,^{8,10} that our findings suggest that the use of these websites may be associated with potential savings, based on the reported number of avoided in-person medical visits.

Strengths and limitations

The main limitation of our study was that we used a convenience sample, as website users participated on a voluntary basis by responding to a questionnaire that was available online to any Internet user. This could be a source of selection bias, which some authors consider inevitable.²¹ On the other hand, in the 8-week window that the questionnaire was available, only 0.5% of the total individual users of the website participated in the survey, so we cannot assume that the sample is representative of the total users of the website, which hinders the extrapolation of our findings. Lastly, the calculation of the costs and potential savings were based on official publications of the PHSA, which is a more objective source but also partly limits the findings of our study, as the results could vary based on the wages and prices of other autonomous communities in Spain or other countries. Lastly, the website development, hosting and maintenance costs could be higher if professional services were used.

The main strength of our study is that, despite the low response rate of 0.5% by website users, the sample included 516 participants, a number that exceeds the recommended sample size by other authors for studies of this nature.²² In addition, the questionnaire that we used to assess the website and the usefulness domain, the purpose of which was to calculate potential savings, had been previously validated through exploratory and confirmatory factor analyses, which increases the validity of the results.

Conclusions

The costs associated with the development of a paediatric eHealth website for parents in Spanish using existing free technology were low compared to other strategies of eHealth development. In addition, the costs were quite low relative to the total number of visits or the total number of individual users. Lastly, websites of this kind may lead to substantial savings by helping reduce visits to paediatric primary care and emergency care services.

Conflicts of interest

The authors have no conflicts of interest to declare.

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